(12) UK Patent Application (19) GB (11) 2 179 613 (13) A

(43) Application published 11 Mar 1987

(21) Application No 8618722

(22) Date of filing 31 Jul 1986

(30) Priority data

(31) 761691 (32) 2 Aug 1985 (33) US

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(51) INT CL[4]
B64D 45/00

(52) Domestic classification (Edition I)
B7W 45

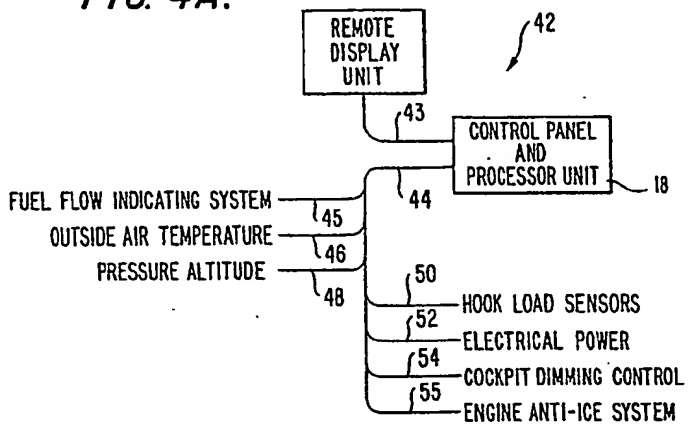
(56) Documents cited
None

(58) Field of search
B7W
Selected US specifications from IPC sub-class B64D

(54) A helicopter weight and torque advisory system

(57) A helicopter weight and torque advisory system for connection to cargo hook load sensors, fuel flow, air temperature and altitude indicating systems of a helicopter. The advisory system provides the flight crew of the helicopter information as to available engine torque, gross weight, gross weight center of gravity condition, and weight supported by each cargo hook as an external sling load is raised and supported by the helicopter. Also information as to required engine torque for maximum helicopter range and endurance performance is provided.

FIG. 4A.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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FIG. 1.

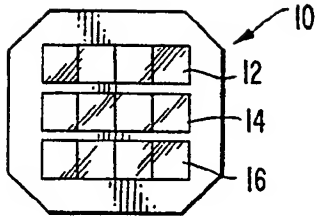

FIG. 2.

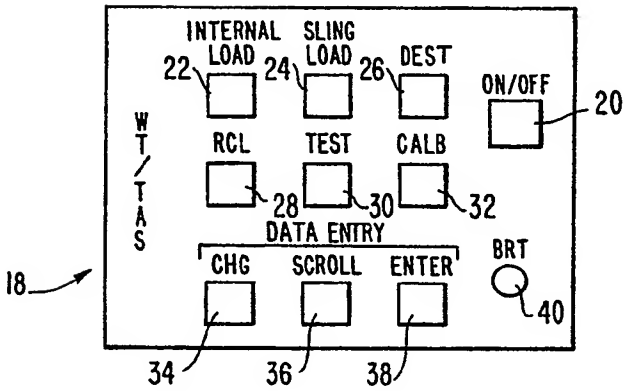

FIG. 3.

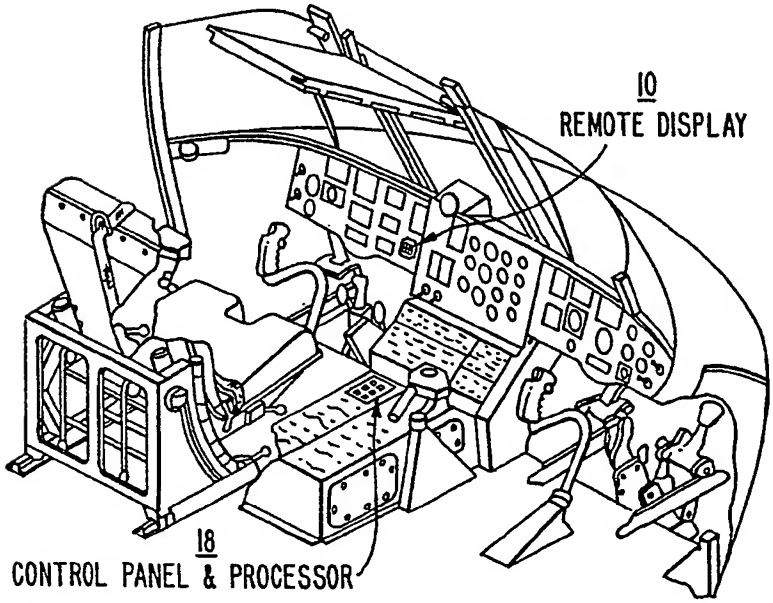

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FIG. 4A.

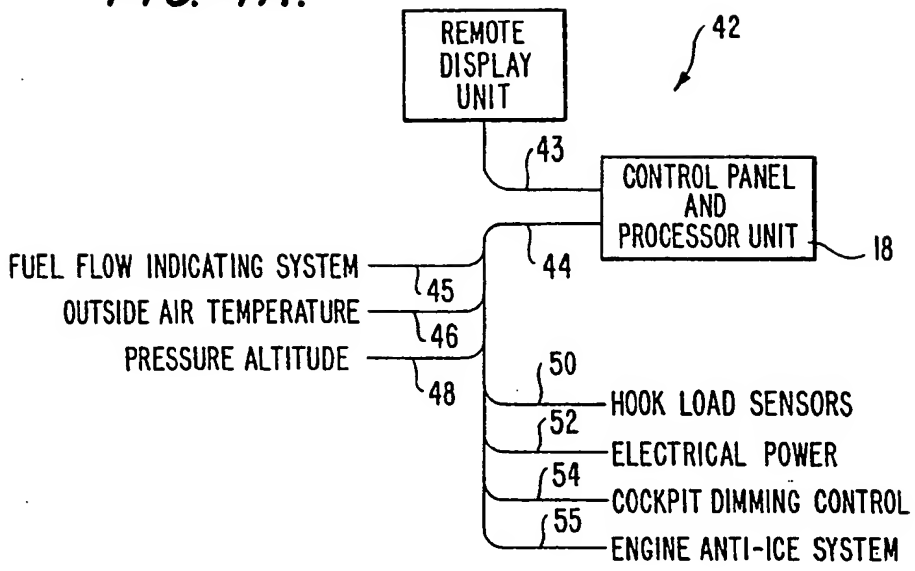
REMOTE DISPLAY UNIT
42
43
CONTROL PANEL AND PROCESSOR UNIT
18
44
FUEL FLOW INDICATING SYSTEM
45
OUTSIDE AIR TEMPERATURE
46
PRESSURE ALTITUDE
48
50
HOOK LOAD SENSORS
52
ELECTRICAL POWER
54
COCKPIT DIMMING CONTROL
55
ENGINE ANTI-ICE SYSTEM

FIG. 4B.

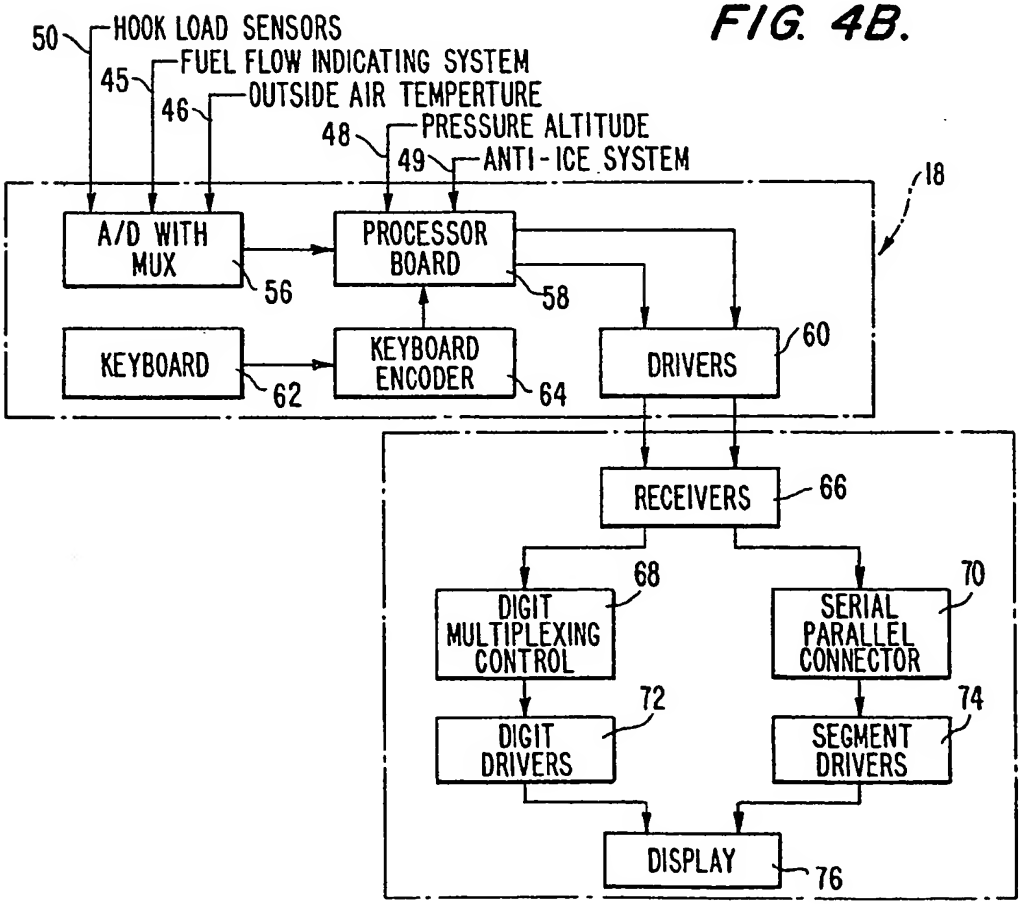
50
HOOK LOAD SENSORS
45
FUEL FLOW INDICATING SYSTEM
46
OUTSIDE AIR TEMPERTURE
48
PRESSURE ALTITUDE
49
ANTI-ICE SYSTEM
18
A/D WITH MUX
56
PROCESSOR BOARD
58
KEYBOARD
62
KEYBOARD ENCODER
64
DRIVERS
60
RECEIVERS
66
DIGIT MULTIPLEXING CONTROL
68
SERIAL PARALLEL CONNECTOR
70
DIGIT DRIVERS
72
SEGMENT DRIVERS
74
DISPLAY
76

FIG. 5A.

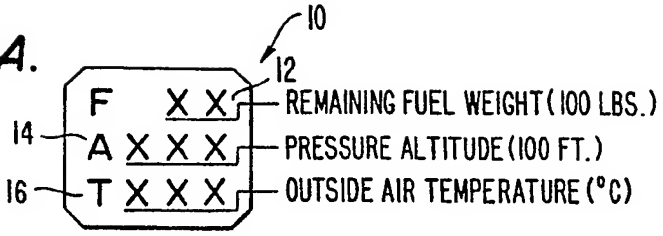

FIG. 5B.

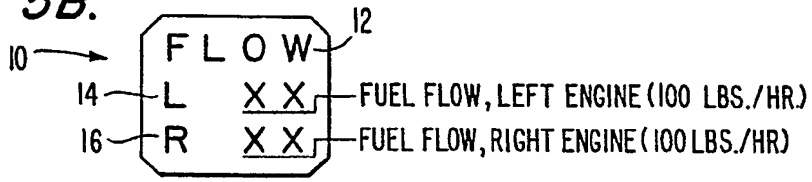

FIG. 5C.

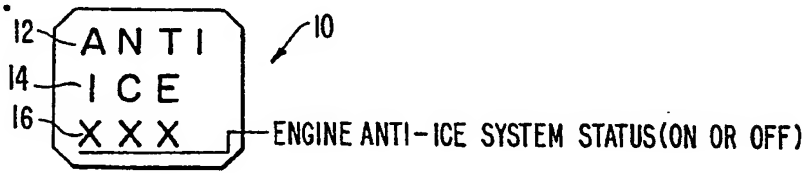

FIG. 5D.

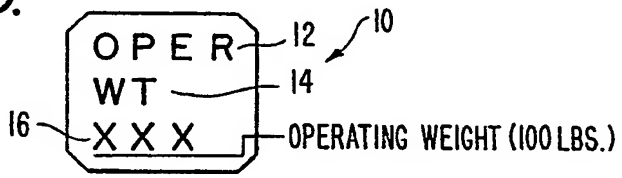

FIG. 5E.

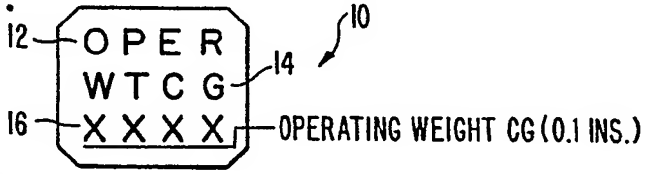

FIG. 5F.

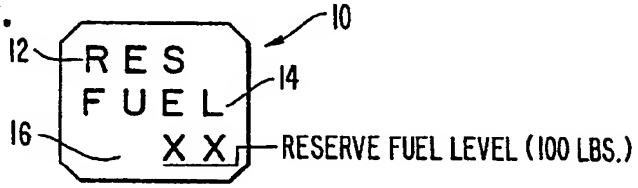

FIG. 5G.

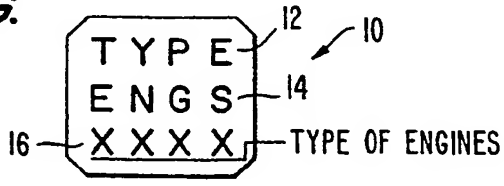

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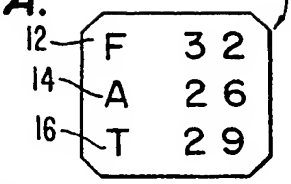
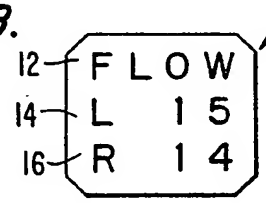
FIG. 6A.



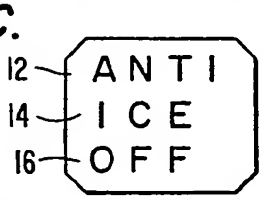
REMAINING FUEL WEIGHT 3,200 LBS.
ALTITUDE 2,600 FT.
TEMPERATURE 29° C

FIG. 6B.



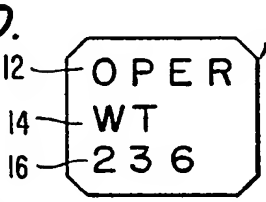
FUEL FLOW RATE TO
LEFT ENGINE 1,500 LBS./HR. AND TO
RIGHT ENGINE 1,400 LBS./HR.

FIG. 6C.



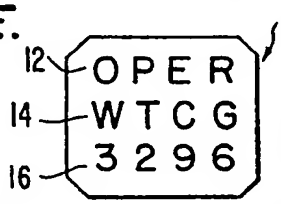
ANTI-ICE SYSTEM OFF

FIG. 6D.



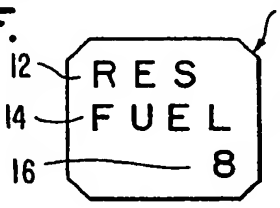
OPERATING WEIGHT 23,600 LBS.

FIG. 6E.



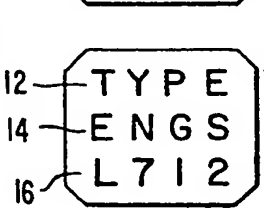
OPERATING WEIGHT CG
AT STA 329.6 INCHES

FIG. 6F.



RESERVE FUEL LEVEL 800 LBS.

FIG. 6G.



TYPE OF ENGINES ARE L712

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FIG. 7A.

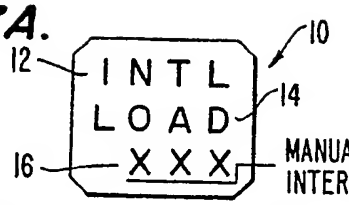

FIG. 7B.

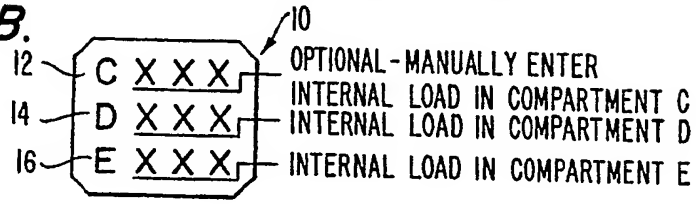

FIG. 8A.

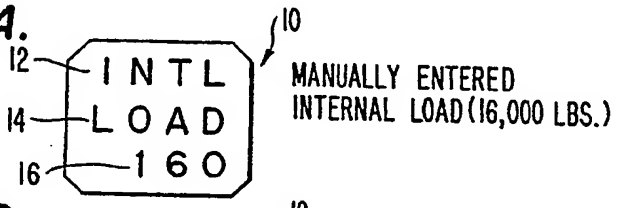

FIG. 8B.

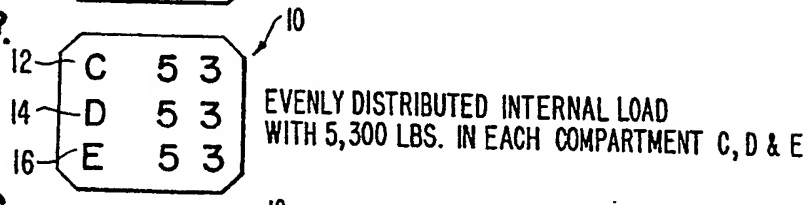

FIG. 8C.

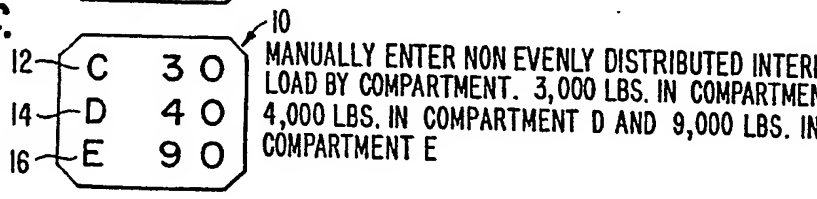

FIG. 9A.

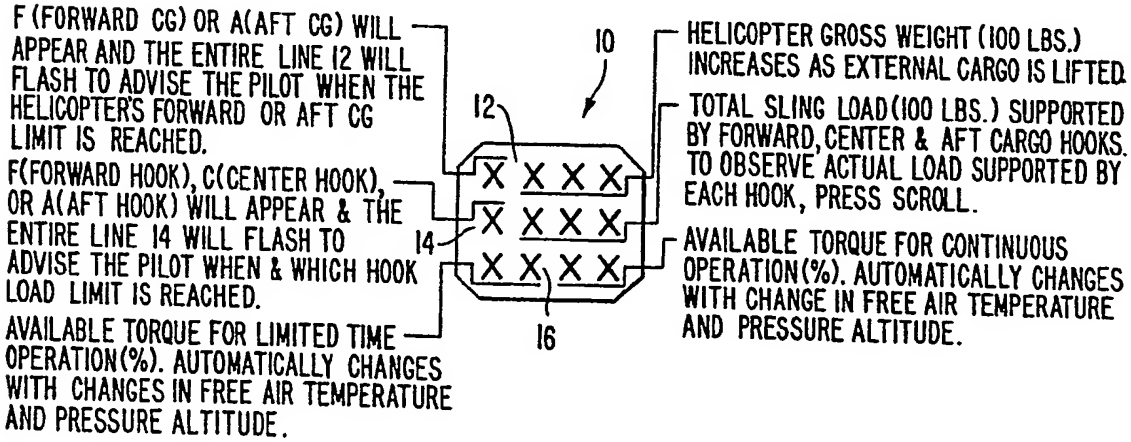

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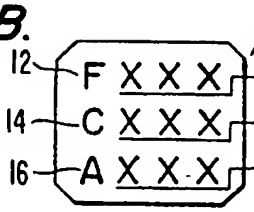
FIG. 9B.



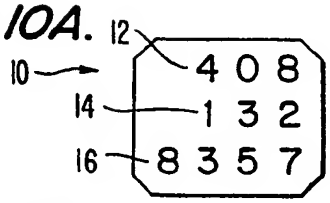
LOAD SUPPORTED BY FORWARD HOOK (F)

LOAD SUPPORTED BY CENTER HOOK (C)

LOAD SUPPORTED BY AFT HOOK (A)

ALL DISPLAYED LOAD VALUES CHANGE AS EXTERNAL LOAD IS LIFTED. IF A HOOK LOAD LIMIT IS REACHED, THE ENTIRE LINE FOR THAT PARTICULAR HOOK WILL FLASH.

FIG. 10A.

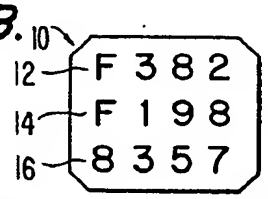


GROSS WEIGHT 40,800 LBS.

EXTERNAL LOAD 13,200 LBS.

AVAILABLE TORQUE FOR LIMITED OPERATION (10 MIN.) IS 83% AND FOR CONTINUOUS OPERATION IS 57%.

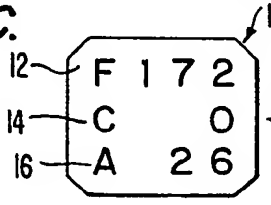
FIG. 10B.



FORWARD CG LIMIT EXCEEDED AT GROSS WEIGHT 38,200 LBS.-LINE 12 FLASHES.

FORWARD CARGO HOOK LIMIT EXCEEDED-LINE 14 FLASHES.

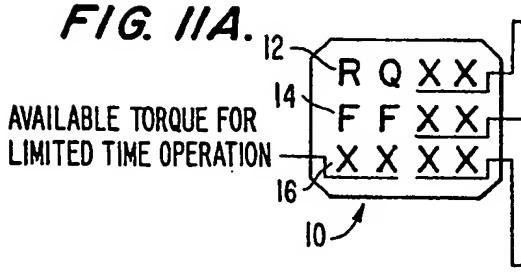
FIG. 10C.



FORWARD HOOK LOAD LIMIT (17,000 LBS.) IS EXCEEDED-LINE 12 FLASHES. 17, 200 LBS. LOAD INDICATED ON FORWARD HOOK (F).

NO LOAD INDICATED ON CENTER HOOK (C) AND 2,600 LBS. LOAD INDICATED ON AFT HOOK (A).

FIG. 11A.

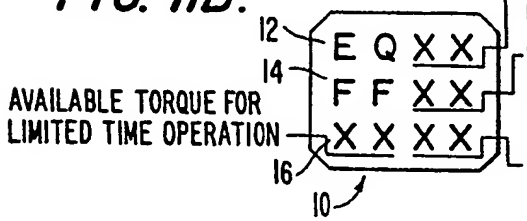


TORQUE (%) REQUIRED PER ENGINE FOR MAX. RANGE. CHANGES AS GROSS WEIGHT CHANGES DUE TO FUEL BURN, FREE AIR TEMPERATURE, AND PRESSUE ALTITUDE CHANGES.

FUEL FLOW RATE (10LBS.) PER ENGINE FOR MAX. RANGE. CHANGES AS TORQUE REQUIRED FOR MAX. RANGE CHANGES.

AVAILABLE TORQUE FOR CONTINUOUS OPERATION.

FIG. 11B.



TORQUE(%) REQUIRED PER ENGINE FOR MAX ENDURANCE CHANGES AS GROSS WEIGHT CHANGES DUE TO FUEL BURN, FREE AIR TEMPERATURE,& PRESSURE ALT. CHANGES.

FUEL FLOW RATE(10LBS.) PER ENGINE FOR MAX. ENDURANCES. CHANGES AS GROSS WEIGHT CHANGES DUE TO FUEL BURN, FREE AIR TEMP. & PRESS. ALTITUDE CHANGES

AVAILABLE TORQUE FOR CONTINUOUS OPERATION

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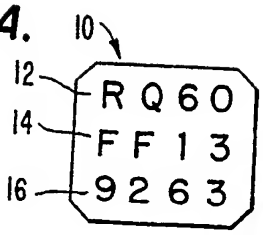
FIG. 12A.

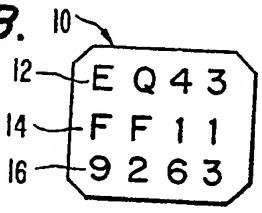


TORQUE REQUIRED PER ENGINE FOR MAX. RANGE AS A FUNCTION OF FUEL REMAINING, TEMPERATURE, ALTITUDE AND EXTERNAL CARGO LOAD IS 60%.

THE FUEL FLOW RATE PER ENGINE FOR MAX. RANGE IS 1,300 LBS./HR.

THE AVAILABLE TORQUE FOR A LIMITED OPERATION (10 MIN.) IS 92% & CONTINUOUS OPERATION IS 63%

FIG. 12B.

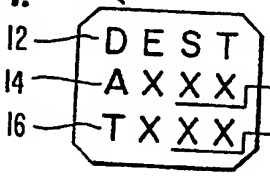


TORQUE REQUIRED PER ENGINE FOR MAX. ENDURANCE AS A FUNCTION OF FUEL REMAINING, TEMPERATURE, ALTITUDE AND EXTERNAL CARGO LOAD IS 49%.

THE FUEL FLOW RATE PER ENGINE FOR MAX. ENDURANCE IS 1,100 LBS./HR.

THE AVAILABLE TORQUE FOR A LIMITED OPERATION (10 MIN.) IS 92% & CONTINUOUS OPERATION IS 63%.

FIG. 13A.

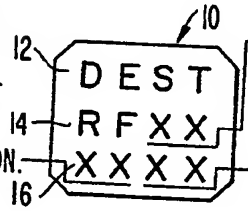


ALTITUDE AT DESTINATION (100 FT.) MANUAL INPUT

OUTSIDE AIR TEMPERATURE AT DESTINATION (°C)- MANUAL INPUT

FIG. 13B.

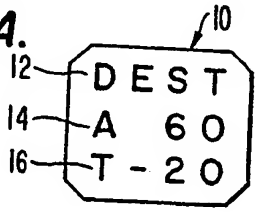
TORQUE AVAILABLE AT DESTINATION FOR LIMITED TIME OPERATION.



REMAINING FUEL AT DESTINATION (100 LBS.)-MAN. INPUT

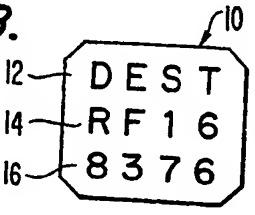
TORQUE REQUIRED AT DESTINATION FOR LIMITED TIME OPERATION BASED ON ACTUAL EXTERNAL LOAD AND THE PROJECTED ALTITUDE, TEMPERATURE & REMAINING FUEL AT DESTINATION IF THE REQUIRED TORQUE IS GREATER THAN AVAILABLE TORQUE. THE REQUIRED VALUE WILL FLASH.

FIG. 14A.



MANUALLY ENTERED ESTIMATED ALTITUDE OF 6,000 FT. AND TEMPERATURE -20°C AT DESTINATION

FIG. 14B.



MANUALLY ENTER ESTIMATED FUEL OF 1,600 LBS. REMAINING AT DESTINATION.

COMPUTED AND DISPLAYED AVAILABLE TORQUE AND REQUIRED TORQUE AT DESTINATION FOR LIMITED OPERATION (83% IS AVAILABLE AND 76% IS REQUIRED).

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FIG. 15.

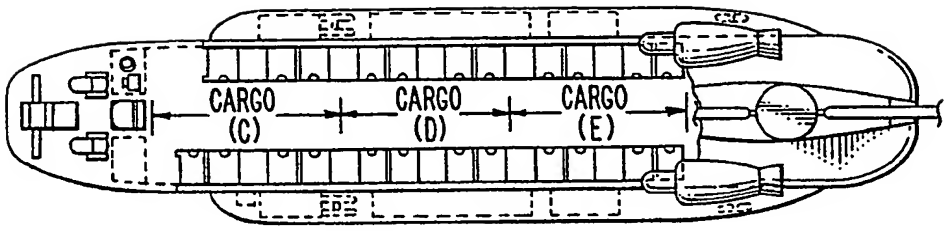
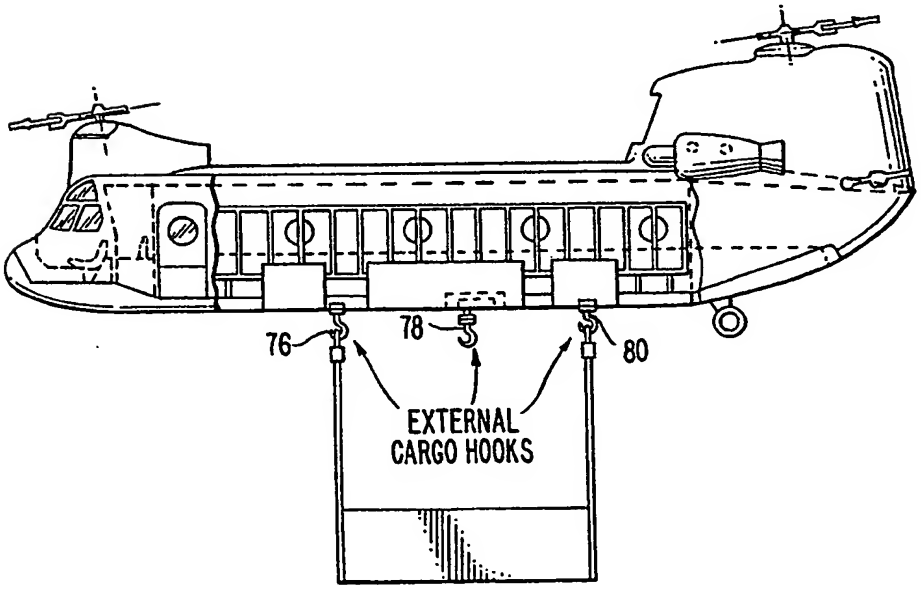


FIG. 16.



BNSDOCID: <GB_____2179613A_I_>

SPECIFICATION

A helicopter weight and torque system

Background of the invention

The invention relates to a helicopter advisory system and more particularly, but not by way of limitation, to a system for providing to a flight crew the helicopter's "real time" available engine torque, gross weight, gross weight center of gravity condition, the total and individual weight supported by each cargo hook and optimum engine torque required for maximum range and endurance time performance.

Heretofore, helicopter pilots have not had an automated means of knowing "real time" available engine torque to use in conjunction with their engine torque meter when lifting external cargo loads or an advisory system to assist them in obtaining optimum helicopter performance as a function of actual external cargo loads. The present flying process requires observing helicopter instruments and then manually referring to performance hook up tables and charts for available engine torque and performance data. This process is time consuming, cumbersome and subject to error which contributes to helicopter structural damage, inability to complete missions and accidents.

Prior attempts to determine the helicopter condition during the lifting of external cargo did not incorporate the use of "real time" inputs for temperature and altitude to compute and display engine torque available.

The subject helicopter weight and torque advisory system eliminates the above-mentioned problems and provides unique features and advantages heretofore not available to flight crews during helicopter flight.

Summary of the invention

The helicopter weight and torque advisory system consists of two electronic components; a control panel with processor unit and a remote display unit. Electrical power, along with signals from the outside air temperature, pressure altitude, fuel flow and anti-ice systems and the external sling load cargo hook load sensors are fed into the control panel processor unit.

Prior to lifting an external cargo load the subject helicopter weight and torque advisory system displays to the pilot the available engine torque and then during the lifting of an external cargo load it will display in real time the helicopter gross weight and its total sling load weight. Further, the system will advise the pilot during the lifting operation when the gross weight, gross weight center of gravity, or a hook load limit is reached. After the load has been safely lifted the subject system will advise the pilot as to what his optimum engine torque and associated fuel flow rate should be for both maximum range and maximum endurance operations based on actual external load lifted, fuel remaining, altitude and temperature and status of anti-ice system. A dedegration in performance exists when the engine anti-ice system is on.

The operating weight empty and operating weight empty center of gravity location are manually entered and changed using the system procesor's non volatile memory. Total fuel weight is entered manually at start of mission only if tanks are less than full. The remaining fuel value is automatically computed by the processor continuously throughout the mission from discrete signals supplied by fuel flow sensors.

The internal cargo load weight is inputed manually and is distributed evenly by the system processor over all cargo compartments. If the internal load should not be evenly distributed, individual compartment load weights may be entered manually.

The helicopter weight and torque advisory system also has the capability to compute and display the available versus required engine torque at selected destination points based on the helicopter's operating weight and internal payload in the processor's memory, the actual external cargo load lifted, and manually input projected altitude, temperature and remaining fuel at destination.

Another unique feature of the system is that the pilot can enter a desired fuel reserve level and the display will advise him when that level is reached.

The advisory system's memory has the capability to store different sets of performance data applicable to different types of engines that may be installed on a helicopter model. The operator may manually select the appropriate engine which is retained in memory automatically for future missions.

Upon command the system will display "real time" fuel remaining, fuel flow rate, altitude, temperature, the status of the anti-ice system and the actual load on each cargo hook. In addition, manually input and maintained data such as operating weight, operating weight center of gravity, reserve fuel level and type of engines in the processor's memory are available for quick display.

The control panel portion of the control panel and processor unit consists of an ON/OFF switch, three mode switches, i.e., internal cargo load (INTL), sling load (SLING), and engine torque at destination (DEST). Also, it contains a recall key (RCL), a test key (TEST) and a calibration key (CALB). Further, it includes three data keys, CHANGE, SCROLL and ENTER, and a remote display brightness control knob.

The remote display unit interfaces only with the control panel and processor unit. Its display consists of three lines with each line capable of displaying four alpha-numeric characters.

The remote display unit and control panel and processor unit are small for maximum utilization of existing available space without disturbing other equipment in the helicopter's cockpit.

The advantages and objects of the invention will become evident from the following detailed description of the drawings when read in connection with the accompanying drawings which illustrate preferred embodiments of the invention.

Brief description of the drawings

Figure 1 illustrates the display arrangement of the

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remote display unit.

Figure 2 illustrates the control panel of the control panel and processor unit.

Figure 3 illustrates a cockpit of a helicopter with the remote display unit and control panel and processor unit.

Figures 4A and *4B* illustrate a system diagram of the advisory system and the control panel and processor unit and remote display unit electronic components.

Figures 5A, 5B, 5C, 5D, 5E, 5F and *5G* illustrate the display formats when the on/off switch is engaged.

Figures 6A, 6B, 6C, 6D, 6E, 6F and *6G* illustrate example displays when the on/off switch is engaged.

Figures 7A and *7B* illustrate the display formats when the internal load switch (INTL) is engaged.

Figures 8A, 8B and *8C* illustrate example displays when the internal load switch (INTL) is engaged.

Figures 9A and *9B* illustrate the display formats when the sling load switch (SLING) is engaged for external load lifting operations.

Figures 10A, 10B and *10C* illustrate example displays when the sling load switch (SLING) is engaged for external load lifting operations.

Figures 11A and *11B* illustrate display formats when the sling load switch (SLING) is engaged for maximum range and endurance operations.

Figures 12A and *12B* illustrate example displays when the sling load switch (SLING) is engaged for maximum range and endurance operations.

Figures 13A and *13B* illustrate the display formats when the destination switch (DEST) is engaged.

Figures 14A and *14B* illustrates the example displays when the destination switch (DEST) is engaged.

Figure 15 illustrates the location of cargo compartments in an example application using a CH-47D helicopter.

Figure 16 illustrates the location of the external cargo hooks on the CH-47D helicopter.

Detailed description of the drawings

In Figure 1 the remote display unit display is designated by general reference numeral 10. The display 10 includes three lines 12, 14 and 16 each capable of displaying four alpha-numeric characters.

In Figure 2, the control panel and processor unit control panel is shown and designated by general reference 18. The control panel 18 includes an on/off switch 20 and three display mode switches, internal load (INTL) 22, sling load (SLING) 24 and destination (DEST) 26.

A second line includes a recall (RCL) key 28, test key 30 and calibration (CALB) key 32. Further a third line includes three data entry keys, CHANGE 34, SCROLL 36 and ENTER 38. On the control panel 18 a display brightness control knob 40 is included for regulating the brightness from the remote display (10).

Illustrated in Figure 3 is a cockpit of a U.S. Army CH-47D helicopter showing where typically, the remote display unit 10 and the control panel and processor unit 18 can be mounted. The remote display unit and control panel processor unit are small enough for potential installation in existing space without disturbing the various equipment used in a helicopter's cockpit.

In Figure 4A a system diagram is shown which illustrates the interface between the helicopter weight and torque advisory system designated by general reference numeral 42 and other helicopter systems. In this diagram, the remote display unit 10 is shown connected to the control panel and processor unit 18 via lead 43. The unit 18 is connected via lead 44 to lead 45 which is attached to the fuel flow inducting system. Lead 44 is also connected to lead 46 attached to the outside air temperature sensor system, to lead 48 attached to the altitude indicating system, to lead 50 attached to the cargo hook load sensors, to lead 52 attached to the electrical power system, to lead 54 attached to the cockpit dimming control switch and to lead 55 attached to the engine anti-ice system.

In Figure 4B the example CH-47D system interface with the control and processor unit 18 is shown for storing and calculating the helicopter available engine torque, gross weight, gross weight center of gravity, weight supported by cargo hooks, and torque and fuel flow rate for maximum range and endurance time performance. The cargo hook load sensors, fuel flow and outside air temperature systems are connected to an analog to digital converter with multiplexer 56 via leads 45, 46 and 50. The converter 56 is connected to a processor board 58 which in turn is connected to drivers 60. The pressure altitude and anti-ice systems are connected directly to the processor board 58 via leads 48 and 49. A keyboard 62 of the unit 18 is connected to an encodes 64 which in turn is connected to the processor board 58. The drivers 60 are connected to receivers 66 in the remote display unit 10. The receivers 66 are connected to a digit multiplexing control 68 and a serial parallel converter 70. The control 68 is connected to digit drivers 72 and the converter 70 is attached to segment drivers 74. The drivers 72 and 74 are connected to the display module 76.

Referring now to Figure 5A and prior to the start of a mission, the operator turns the system on using the on/off switch 20 on the control panel 18. The display 10 will indicate the full fuel weight on the first line 12, pressure altitude on the second line 14 and the outside air temperature on the third line 16. If the fuel gauge indicates less than full the operator must input the indicated fuel gauge value into the system. The system will then automatically adjust the displayed total fuel remaining as fuel is consumed by the engines. The displayed altitude and temperature should agree with the altimeter and outside air temperature instruments.

The operator would press the SCROLL key 36 on the control panel 18 to view the fuel flow rate Figure 5B, which should agree with the fuel flow instrument, and the anti-ice system status display, Figure 5C, which will indicate anti-ice system on or off.

The data entry keys on the control panel 18, i.e., CHANGE 34, SCROLL 36, and ENTER 38 are used to change the displayed data. The process for entering or updating the displayed data consists of pressing the change key 34 which starts the cursor of the display unit 10 blinking at the first data character position. If no change is required at this position, the operator then presses the enter key 38 and the cursor

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will shift to the next character position. If a character is to be entered or updated, the operator then presses the SCROLL key 36 to bring up the desired character and then the ENTER key 38 is pressed. The cursor will automatically at the end of the line, skip to the first data character on the next line.

The manual inputs stored in the non volatile memory can be viewed by the operator by pressing the SCROLL key 36 on the control panel 18. The stored data consists of the helicopter operating weight (zero fuel and pay load), Figure 5D, the operating weight center of gravity, (balance location), Figure 5E, the reserve fuel level, Figure 5F.

The reserve fuel level, Figure 5F is inputed by the operator and will automatically appear and flash when reached. The default reserve fuel level is zero.

If a helicopter model series has different types of engines, different types of performance data will be required in the memory. Figure 5G is used to identify the type of engines used for performance computation.

Figures a, b, 6C, 6D, 6F and 6G are examples of the display formats that would appear when the system is turned on and the SCROLL key is used to bring up displays. The original display format 5A will appear after the SCROLL key is used when Figure 5G is displayed.

The operator must manually enter the internal cargo load weight into the system processor prior to the lifting of the external sling load. This is accomplished by first engaging the INTERNAL LOAD switch 22 on the control panel 18 which brings up format Figure 7A and then using the data entry keys CHG 34, SCROLL 36 and ENTER 38. The system automatically distributes the displayed internal cargo load weight evenly over the internal cargo compartments C, D and E which are shown in Figure 15. This weight distribution may be viewed by pressing the SCROLL key and the display format would be as shown in 7B. If the internal cargo load weight is not distributed evenly, the operator would enter the unevenly distributed load by cargo compartment, into the processor using the SCROLL key 36 to bring up Figure 7B format and the data entry keys CHG 34, SCROLL 36 and ENTER 38. Figures 8A and 8B illustrate an example of a 16,000 pound internal payload evenly distributed and Figure 8C illustrates a non-evenly distributed internal payload.

Prior to lifting an external load, the operator would engage the sling load switch (SLING) 24. The display format that will appear is shown in Figure 9A. As the external sling load is raised, the helicopter gross weight shown in the last three positions of line 12 of the display 10 would increase, as well as the total sling load weight shown in the last three positions of line 14 of the display 10.

The engine torque available for a limited time duration is displayed in the first two positions of line 16 of the display 10 and the engine torque available for sustained operation is displayed in the last two positions of line 16 of the display 10 as shown in Figure 9A. These displayed torque available values automatically change as the outside air temperatures and pressure altitude change.

An example display without adverse helicopter centre of gravity of hook load condition is shown in Figure 10A.

If the helicopter gross weight limit is exceeded the displayed gross weight, last three positions of line 12 on display 10 Figure 9A would flash. If an adverse helicopter balance (center of gravity) condition occurs, a "F" for forward CG limit condition of an "A" for aft CG limit condition would appear in the first position of line 12 of the display 10 Figure 9A and the entire line would start flashing. If the weight limit of an external cargo hook, 76, 78 or 80 shown in Figure 16 is exceeded when lifting a load, the hook that is overloaded will appear in the first position of line 14 of the display 10 Figure 9A and the entire line 14 of the display 10 Figure 9A will flash. An "A" in the first position would indicate forward hook 76, "C" the center hook 78 and "D" the aft hook 80. An example display of showing the helicopter forward GC limit exceeded and the forward cargo hook overload is shown in Figure 10B.

To view the individual sling load weights, the operator would press the SCROLL key 36 and the display format 9B displaying the individual loads support by each hook would be displayed. Line 12 of display 10 in Figure 9B indicates the forward hook position (F) and the weight it is supporting. Line 14 of display 10 in Figure 9B indicates the center hook position (C) and the weight it is supporting. Line 16 of display 10 in Figure 9B indicates the aft hook position (A) and the weight it is supporting. If any of the hook load weight limits are exceeded the weight value and its hook identification symbol (F,C,A) would flash. An example display is shown in Figure 10C.

The scroll key is pressed again to view the optimum engine torque, line 12 of display 10, and the associated engine fuel flow rate, line 14 of display 10 for maximum range, as shown in Figure 11A. The available engine torque for limited time and extended time operation will be displayed on line 16 of display 10, as shown in Figure 11A. An example display for maximum range is Figure 12A. The SCROLL key is pressed again to bring up the optimum engine torque, line 12 of display 10 and the associated engine fuel flow rate, line 14 of display 10 for maximum endurance time, as shown by Figure 11B. The available engine torque for limited time and extended operations will be displayed on line 16 of display 10, as shown in Figure 11B. An example display for maximum endurance time is Figure 12B.

To return to the original sling load format display 9A, the operator would press the sling load switch (SLING) 24.

The destination switch (DEST) is used to determine the engine torque available versus engine torque required at the mission destination point based on the operating weight, and internal load in the systems processor's memory, the actual sling load, and the manually input anticipated remaining fuel weight, altitude and temperature at the mission destination point. When the destination switch 26 is engaged, the previously entered anticipated destination, altitude and air temperature would be displayed as shown in Figure 13A and in the example Figure 14A. These values may be changed by the operator using the data entry keys. Next, the operator would press the

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scroll key 36 to display the previously entered anticipated remaining fuel at destination value. This value may be changed by the operator using the data entry keys. The destination remaining fuel value is shown on line 14 of Figure 13B and in the example Figure 14B.

The available and required engine torque at destination are displayed on the third line 16 as noted in Figure 13B and 14B. The required torque will flash if it exceed available torque.

The recall key RCL 28, on the control panel 18, is used to display the same data that appears when the system is turned on (Figure 5). The test key, TEST 30, is used for built-in-test purposes. The calibration key CALB 32, is used to calibrate the system processor with the signals from each external cargo hook load cell, fuel flow system and altitude and air temperature indicators.

Changes may be made in the construction and arrangement of the parts or elements of the embodiments as described herein without departing from the spirit or scope of the invention defined in the following claims.

CLAIMS

1. A helicopter weight and torque advisory system connected to a helicopter's power source, cargo hook load sensor, fuel flow indicating system, outside air temperature gauge, pressure altitude gauge and anti-ice system and operated by one of the helicopter's personnel, the system including:

a control panel and processor unit adapted for connection to the aircraft's power source, cargo hook load sensors, fuel flow indicating system, outside air temperature gauge, pressure altitude gauge and anti-ice system, the control panel and processor unit including a computer and necessary memory for storing and calculating the helicopter's remaining fuel weight, fuel flow rate to each of the helicopter's engines, reserve fuel level, operating weight, operating weight center of gravity, available engine torque and individual weight supported by each of the helicopter's cargo hooks as an external load is raised and by each of the hooks of the helicopter; and a remote display unit connected to the processor unit,

the display unit displaying the helicopter's remaining fuel weight, fuel flow rate to each of the helicopter's engines, reserve fuel level, operating weight, operating weight center of gravity and available torque for a limited time operation and available torque for a continuous operation.

2. The system as described in Claim 1 wherein the remote display unit displays if the anti-ice system is on or off.

3. The system as described in Claim 1 wherein the remote display unit displays type of engine of the helicopters.

4. The system as described in Claim 1 wherein the control panel and processor unit stores and calculates internal loads in individual compartments and the remote display unit indicates if the internal loads are evenly distributed or non-evenly distributed in the compartments.

5. The system as described in Claim 1 wherein the remote display unit displays individual external loads supported by a forward hook, a center hook and an aft hook of the helicopter, the control panel and processor unit stores and calculates when external load limits are reached and the remote display unit visually flashing when each of the hook load limits are reached.

6. The system as described in Claim 5 wherein the remote display unit displays total gross weight of helicopter as external cargo is lifted, total weight of external load and available torque for limited and continuous operation.

7. The system as described in Claim 1 wherein the remote display unit displays engine torque required for maximum range as a function of fuel remaining, cargo load and available torque for limited operation and continuous operation.

8. The system as described in Claim 1 wherein the remote display unit displays altitude at destination, outside air temperature at destination, remaining fuel at destination and torque available and required at destination for limited time operation based on the actual external load projected altitude, temperature and remaining fuel at destination.

9. A helicopter weight and torque advisory system connected to a helicopter's power source, hook load sensor, fuel flow indicating system, outside air temperature gauge, pressure altitude gauge, internal load sensor and anti-ice system and operated by one of the helicopter's personnel, the system including:

a control panel and process unit adapted for connection to the aircraft's power source, cargo hook load sensors, fuel flow indicating system, outside air temperature gauge, pressure altitude gauge and anti-ice system, the control panel and processor unit including a computer and necessary memory for storing and calculating the helicopter's remaining fuel weight, fuel flow rate to each of the helicopter's engines, reserve fuel level, operating weight, operating weight center of gravity, engine torque, total gross weight of helicopter as external cargo is lifted by each of the helicopter's cargo hooks and available torque for limited and continuous operation when carrying the external load; and

a remote display unit connected to the processor unit, the display unit displaying the helicopter's remaining fuel weight, fuel flow rate to each of the helicopter's engines, reserve fuel level, operating weight, operating weight center of gravity, individual external load supported by each of the helicopter's hooks and available torque for a limited time operation and available torque for a continuous operation when carrying the external load.

10. The system as described in Claim 9 wherein the remote display unit displays torque required per engine for a maximum range as a function of fuel remaining, fuel flow rate per engine and available torque for limited operation and continuous operation when carrying the external load.

11. The system as described in Claim 9 wherein the remote display unit displays altitude at destination, outside air temperature at destination, remaining fuel at destination and torque available at destination based on the external load carried.

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12. A helicopter weight and torque advisory system substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

Printed for Her Majesty's Stationery Office by
Croydon Printing Company (UK) Ltd, 1/87, D8817356.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

BNSDOCID: <GB_____2179613A__I_>